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Department of Zoology, University College Dublin, Belfield, Dublin, Ireland

# Effects of diet on the growth and reproduction of some Collembola in laboratory cultures

M. I. WALSH and T. BOLGER

With 9 figures

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## 1. Introduction

Selective grazing of fungi by Collembola is of importance because the primary influence of these animals on rates of decomposition appears to be due to their grazing of the microflora. This affects rates of microbial respiration and the relative importance of bacteria and fungi in the flora (HANLON & ANDERSON, 1979). In addition, VISSER & WHITTAKER (1977) and NEWELL (1984a, b) have shown that where selective grazing occurs the structure of the fungal community is altered with associated changes in rates of decomposition. Several authors have suggested that diet may also be an important mechanism of niche separation among soil microarthropods and provide supporting evidence for this through feeding preference tests (MCMILLAN, 1976; MATIĆ & KOLEDIN, 1985).

If species do eat different foods one would expect that they should show preferences for such foods and therefore different species should have different preferences. In addition, optimal foraging theory suggests that species should be more fertile/fecund on their preferred foods (PYKE *et al.*, 1977) and indeed many studies have implied that the preferred foods of Collembola are better for these species (e.g. BENGTSSON *et al.*, 1983; BENGTSSON *et al.*, 1985). The present study investigates whether, under laboratory conditions, different species do show preferences for different fungal species and whether such preferences are reflected in their population dynamics.

## 2. Materials and methods

### 2.1. Test organisms

Four species of Collembola, *Hypogastrura denticulata* (BAGNALL, 1941), *Onychiurus furcifer* (BÖRNER, 1901), *Isotomina thermophila* (AXELSON, 1900) and *Folsomia candida* (WILLEM, 1902) and 9 species of fungi were used in this study. The following fungi, which were recovered from soil in the rhizosphere of Sitka spruce, were used: *Oidiodendron griseum*, *Oidiodendron maius*, *Trichoderma viride*, *Trichoderma polysporum*, Dark sterile isolate (5), Light sterile isolate (4), *Cladosporium* sp., *Penicillium* sp. and *Geotrichum* sp. The animals were cultured in glass crystallizing dishes on a base of plaster of Paris and charcoal mixed in a ratio of 9:1. The fungi were cultured on 5 % malt extract agar.

### 2.2. Preference tests

All possible pairs of fungi were tested for preference using one 9 mm diameter plug, aseptically removed from the growing edge of each of the two fungal colonies being assessed in each test. These were placed 7 cm apart in the crystallising dish which was 9 cm in diameter and had a base of plaster of Paris and charcoal. Twenty animals were introduced into the centre of the dish and the number of insects on each piece of fungus was recorded 15 min, 1, 2 and 4 h after introduction. For an animal to be considered feeding it had to be in direct contact with the disc. The dishes were kept in a darkened incubator during the test (22 °C) to avoid any movement with respect to light source. Five

replicates were used in each test. Replicates were tested for homogeneity using a 2 × 5 contingency table. When the $\chi^2$ values were nonsignificant i.e. the replicates were homogenous, a comparison between numbers on each fungus was made using the normal approximation to the binomial distribution (BAILEY, 1959).

### 2.3. Growth of Collembola populations

The growth in population size of *O. furcifer* and *H. denticulata* was measured on 3 species of fungi; Sterile 4, *T. viride* and *O. griseum*. Ten replicates, each with 15 animals, were assigned to each fungal species. Cultures were maintained in plastic vials 16 mm in diameter on a base of plaster of Paris and charcoal in a ratio of 9 : 1 at laboratory temperatures (15–25 °C). The animals were fed weekly. The population size was monitored by counting from photographs taken weekly. Observations were continued for each species of Collembola until no significant increase in population size occurred on any fungal species over a 5 week period.

### 2.4. Life table analysis

Life tables were produced for *O. furcifer* fed on each of the 3 species of fungus. Approximately 30 eggs were added to each of 15 culture vessels, 25 mm in diameter with a plaster of Paris/charcoal base, which were randomly ascribed to the 3 fungal species. When the eggs hatched fungal mycelium was added and the number of animals alive at the end of each week counted. Eggs were counted and removed twice per week. This experiment ran for 43 weeks.

Leslie matrices were calculated from the life tables using time intervals of one week. The net reproductive rate ($R_0$) was calculated as described by KREBS (1985). This value of $R_0$ indicates the increase in number per generation but, unless generation times of the populations under study are equal, it does not reflect the relative rates of increase in numbers with time. The finite population growth rate ($\lambda$) does this and is calculated as the dominant eigenvalue of the Leslie matrix. The instantaneous rate of increase for a population (r) is equal to ln $\lambda$. Generation time is calculated as $G = \ln R_0/r$ (KREBS, 1985). The stable age distribution is given by the right eigenvector corresponding to the dominant eigenvalue of the Leslie matrix and the reproductive value distribution by the corresponding left eigenvector. The relative contributions of survival and fertility to the differences between populations on the 3 fungal species were determined using the methods of CASWELL (1978) and LEVIN *et al.* (1987).

### 2.5. Allometric growth

Reproduction in Collembola is related to moulting frequency (JANSSEN & JOOSSE, 1987). As *O. furcifer* eats its exuvia it is not possible to accurately assess moulting frequency, therefore its growth in length was used. Approximately 100 eggs were transferred from stock cultures to each of 15 vials, 12 mm in diameter. When the eggs hatched fungus was added. Five animals were removed from each vial weekly and measured, from the first thoracic segment to the end of the anal horns, with an eye-piece micrometer.

### 2.6. Sex ratios

Some species of Collembola have been shown to be facultatively parthenogenetic (GOTO, 1960; PETERSEN, 1971), therefore potential changes in the sex ratio on each of the fungal species were assessed by setting up 5 cultures of *O. furcifer* on each species of fungus, allowing them to grow for 15 weeks, and then determining the sex of the adults on each species of fungus.

## 3. Results

### 3.1. Preference tests

The results of the 45 pairwise comparisons using *O. furcifer, H. denticulata* and *I. thermophila* are given in table 1. *O. furcifer* showed significant preferences in 40 of these tests. Steril 4 was favoured over 8 other species and was the most preferred species. Both *Trichoderma* species were rejected in favour of all the other fungi offered and the agar. There was not such a consistent preference pattern shown by *H. denticulata* but significant preferences were found in 26 of the 45 comparisons. In this case the Sterile 4 species was also favoured most frequently but

Table 1. Feeding preferences of test Collembola species.

| Food | Number of times species preferred | | |
|---|---|---|---|
| | *O. furcifer* | *H. denticulata* | *I. thermophila* |
| *Trichoderma viride* | 1 | 3 | 3 |
| *Trichoderma polysporum* | 0 | 2 | 0 |
| Sterile 4 | 9 | 6 | 3 |
| Sterile 5 | 6 | 3 | 1 |
| *Oidiodendron griseum* | 6 | 1 | 3 |
| *Oidiodendron maius* | 4 | 1 | 4 |
| *Geotrichum* sp. | 5 | 3 | 7 |
| *Penicillium* sp. | 2 | 1 | 0 |
| *Cladosporium* sp. | 5 | 3 | 5 |
| Agar | 2 | 3 | 3 |
| **Total** | **40** | **26** | **29** |

*O. griseum,* which had been favoured by *O. furcifer* in most tests, was disliked and *T. viride* was preferred to 3 of the other fungi offered.

*I. thermophila* is quite an active species and preference tests indicated that it is easily disturbed from eating. Therefore all the preference tests for this species were carried out in a dark room using only red light and not moving the dishes. Significant preferences were shown in 29 of the 45 tests (table 1). *Geotrichium* sp. was the most preferred fungus. Unlike the other two species, *I. thermophila* did not show an overall preference for the sterile forms although it did prefer Sterile 4 to *Geotrichium* and *O. maius* in the individual tests.

The numbers of *I. thermophila* observed on the fungal discs were small, e.g. the comparison of Sterile 5 and *T. polysporum,* of a total of 100 animals used in the test, two were feeding after 15 min, 6 after 1 h, 5 after 2 h and 16 after 4 h. This problem of small numbers of animals feeding was also evident in a short series of seven preference tests carried out using *F. candida.* In addition, this species did not show a hierarchy of preferences as did the other species. Because of the problem of the small numbers observed feeding *I. thermophila* and *F. candida* were not used in the population experiments.

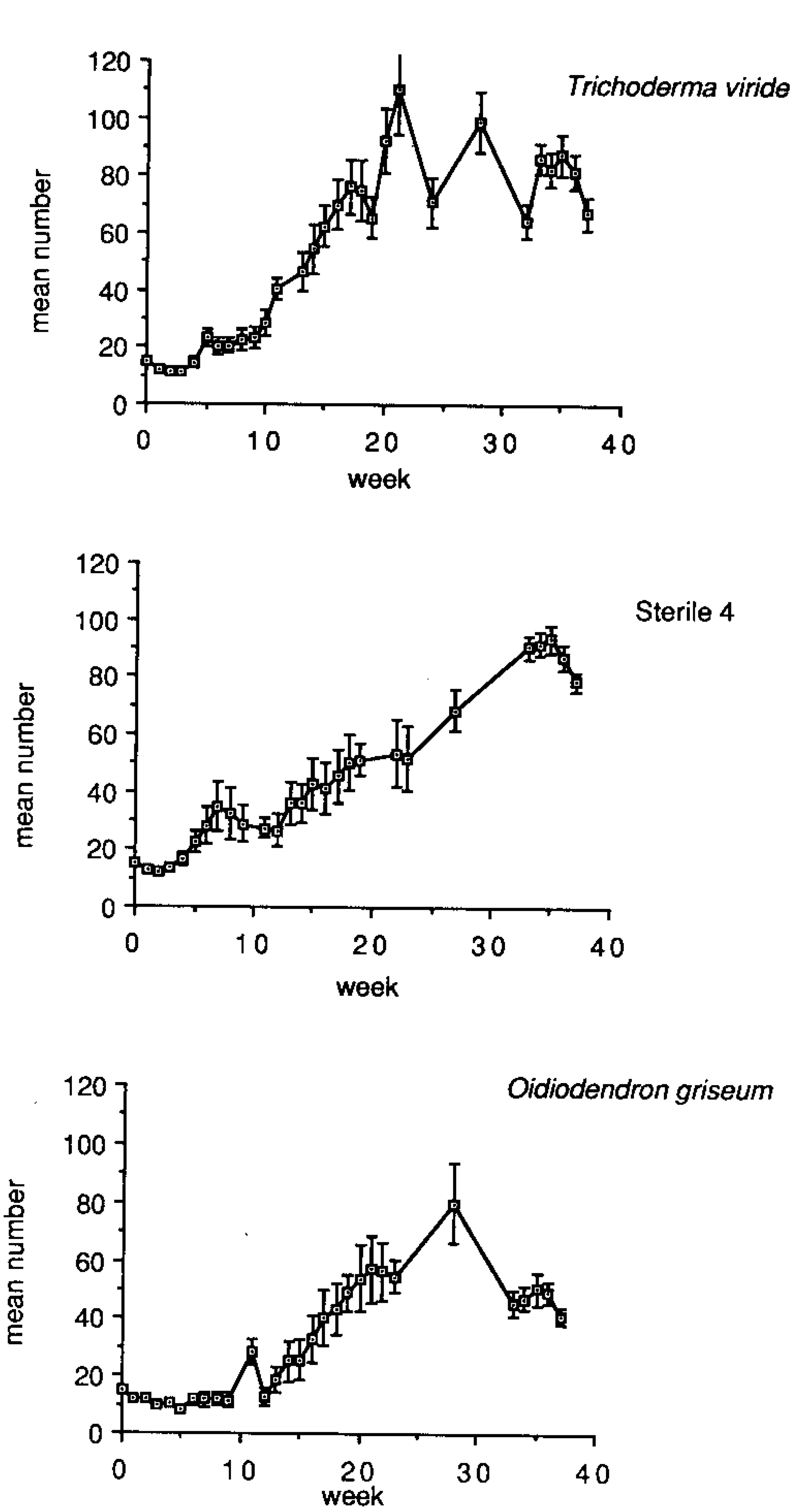
## 3.2. Population growth

Three fungal species were selected for examination based on the preference tests. Sterile 4 was preferred by both *H. denticulata* and *O. griseum* was favoured by *Onychiurus* but to a lesser extent by *Hypogastrura* and the opposite was true of *T. viride* which was liked only by *Hypogastrura*.

The growth of populations of *O. furcifer* differed on all 3 species of fungus (fig. 1). Following an initial establishment period of about 3 weeks the populations on both *T. viride* and Sterile 4 began to grow. No such increase occurred in the populations growing on *O. griseum* until the 11th week. During this period populations were significantly larger on Sterile 4 than on *O. griseum* with those on *T. viride* intermediate in size (F-Prob. $p < .05$).

During weeks 11–22 populations on *T. viride* grew rapidly and were significantly larger than those on *O. griseum.* On three occasions during this period they were also significantly larger than those growing on Sterile 4 but the populations growing on this species gradually increased and eventually became the largest.

Populations on *T. viride* reached their peak in the 21st week, with an average of 110 individuals per vessel, and then gradually declined in an oscillating manner. The numbers of *Onychiurus* on the other 2 species increased more slowly. Those on *Oidiodendron* reached their maximum of 80 per vessel at week 27 while those on Sterile 4 continued to grow until week 37 reaching an average of 93 animals per vessel.



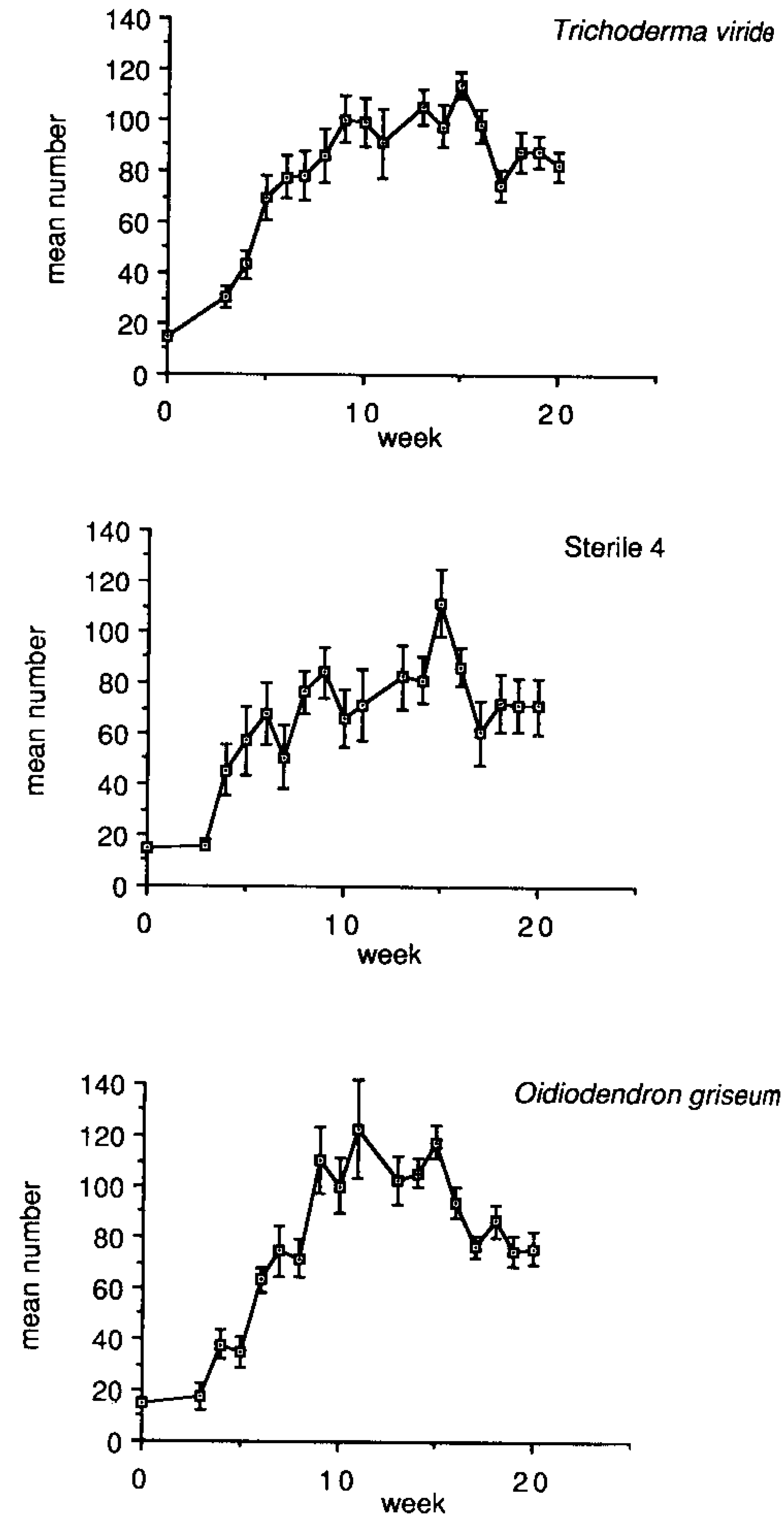




Fig. 1. Population growth of *Onychiurus furcifer* fed on 3 species of fungi. Mean numbers per culture vessel with standard errors.

Fig. 2. Population growth of *Hypogastrura denticulata* fed on 3 species of fungi. Mean numbers per culture vessel with standard errors.

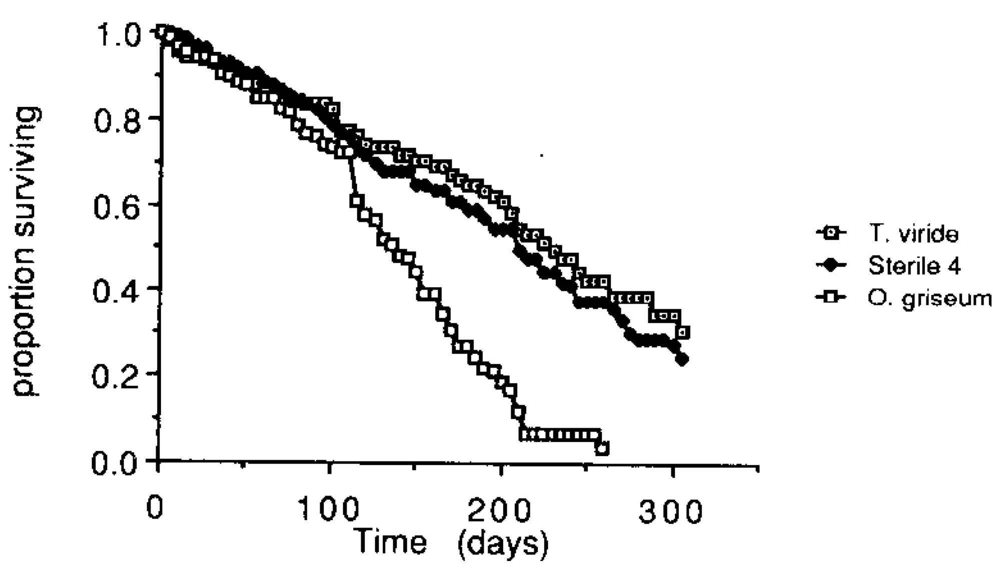



Fig. 3. Survivorship of *Onychiurus furcifer* fed on *Trichoderma viride*, Sterile 4 and *Oidiodendron griseum*.

Populations of *Hypogastrura* increased and fluctuated in a similar manner on all 3 fungal species and no significant differences were noted (fig. 2). Both *T. viride* and Sterile 4 cultures reached a peak on week 14, with 114 and 112 animals per vessel respectively. *O. griseum* reached a peak on week 11 with 122 animals.

Survivorship of *O. furcifer* is significantly influenced by fungal species (fig. 3). The mean survival time for animals fed on *T. viride* was 234.5 d, on Sterile 4 it was 214.7 d and on *O. griseum* it was 141.8 d. Comparisons made using the Lee-Desu statistic (LEE & DESU, 1972) show that survivorship is significantly greater on *T. viride* and Sterile 4 than on *O. griseum* (table 2). The net reproductive rates ($R_0$) i.e. the multiplication rates per generation, were 52.2 on *T. viride*, 47 on Sterile 4 and 37.4 on *O. griseum*. Generation time, the mean period elapsing between birth of parents and birth of offspring, was shortest in *T. viride* cultures at 6.02 weeks compared with 7.2 weeks in Sterile 4 cultures and 7.4 weeks in *O. griseum* cultures. The finite population growth rates were $\lambda = 1.93$ for *T. viride*, $\lambda < 1.7$ for Sterile 4 cultures and $\lambda = 1.63$ for *O. griseum* cultures (table 3).

Table 2. Survivorship of *Onychiurus furcifer*. Comparison of the survivorship of *O. furcifer* on Sterile 4, *T. viride* and *O. griseum* using the Lee- Desu statistic.

| | Lee-Desu | Prob. |
|---|---|---|
| *T. viride*/Sterile 4 | .320 | .5716 |
| *T. viride*/*O. griseum* | 18.041 | .0000 |
| Sterile 4/*O. griseum* | 12.178 | .0005 |

Table 3. Summary of population growth analysis for *Onychiurus furcifer*.

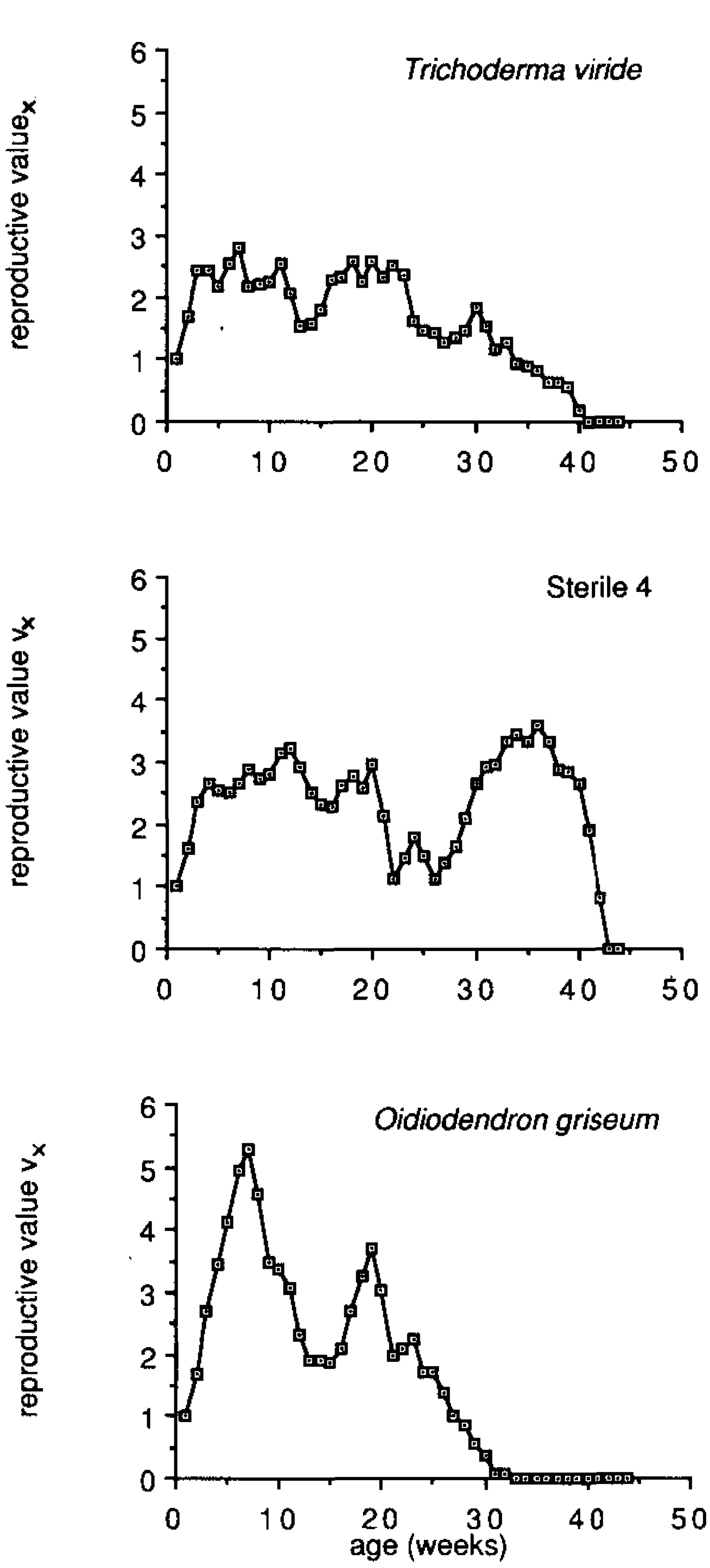
| Food type | $\lambda$ | r | G | $R_0$ |
|---|---|---|---|---|
| *T. viride* | 1.93 | .65 | 6.0 | 52.2 |
| Sterile 4 | 1.70 | .53 | 7.2 | 47.0 |
| *O. griseum* | 1.63 | .48 | 7.4 | 37.4 |

$\lambda$ = finite population growth rate i.e. for each individual present on week x there will be $\lambda$ present on week x + 1;
r = innate capacity for increase;
G = generation time in weeks;
$R_0$ = net reproductive rate ($R_0 = \Sigma l_x \cdot m_x$) where;
$l_x$ = proportion of animals surviving to start of age interval x and
$m_x$ = number of female offspring produced per unit of time per female aged x
time unit = one week.

The age-specific reproductive values ($v_x$), the contribution of individuals of given age to the future population, are illustrated in fig. 4 for each of the 3 populations. In *T. viride* cultures $v_x$ was maximum on week 7 and remained fairly high until week 23 after which it declined to zero on week 41. *O. griseum* cultures also reach a reproductive peak early on, at week 7, with higher $v_x$ values than on either of the other 2 species. However, the curve then declines sharply until week 13, increases from weeks 15–20 then decreases again reaching zero by week 33, earlier than on the other fungi.

Reproductive values on Sterile 4 differ from the other 2 species, the values being quite high for most of its life span. They reach a maximum much later, on week 36, and thereafter decline. All 3 populations appear to have 2 peaks of reproductive activity, on weeks 7 and 18 in *T. viride* cultures, weeks 7 and 19 in *O. griseum* cultures and on weeks 12 and 36 in Sterile 4 cultures.

Given a constant schedule of birth and death rates a population will gradually approach a fixed or stable age distribution and will maintain this indefinitely, whatever the initial age distribution may have been. The stable age distributions of the populations on the 3 fungal species are given in fig. 5. All 3 populations are dominated by young individuals, with few animals more than 10 weeks old. The distributions are quite similar on the different fungi although 50 % of the *T. viride* populations were less than one week old compared with 42 % and 40 % in Sterile 4 and *O. griseum* populations respectively.



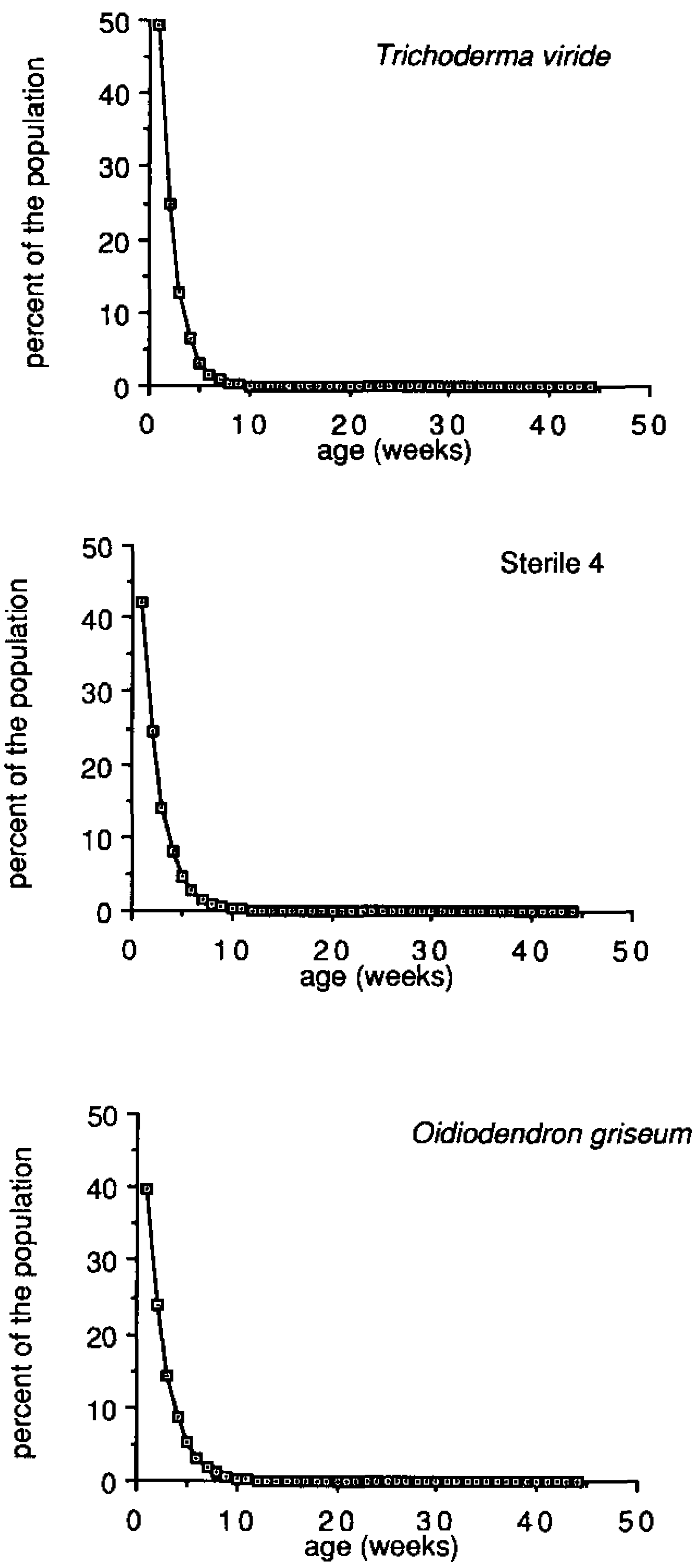



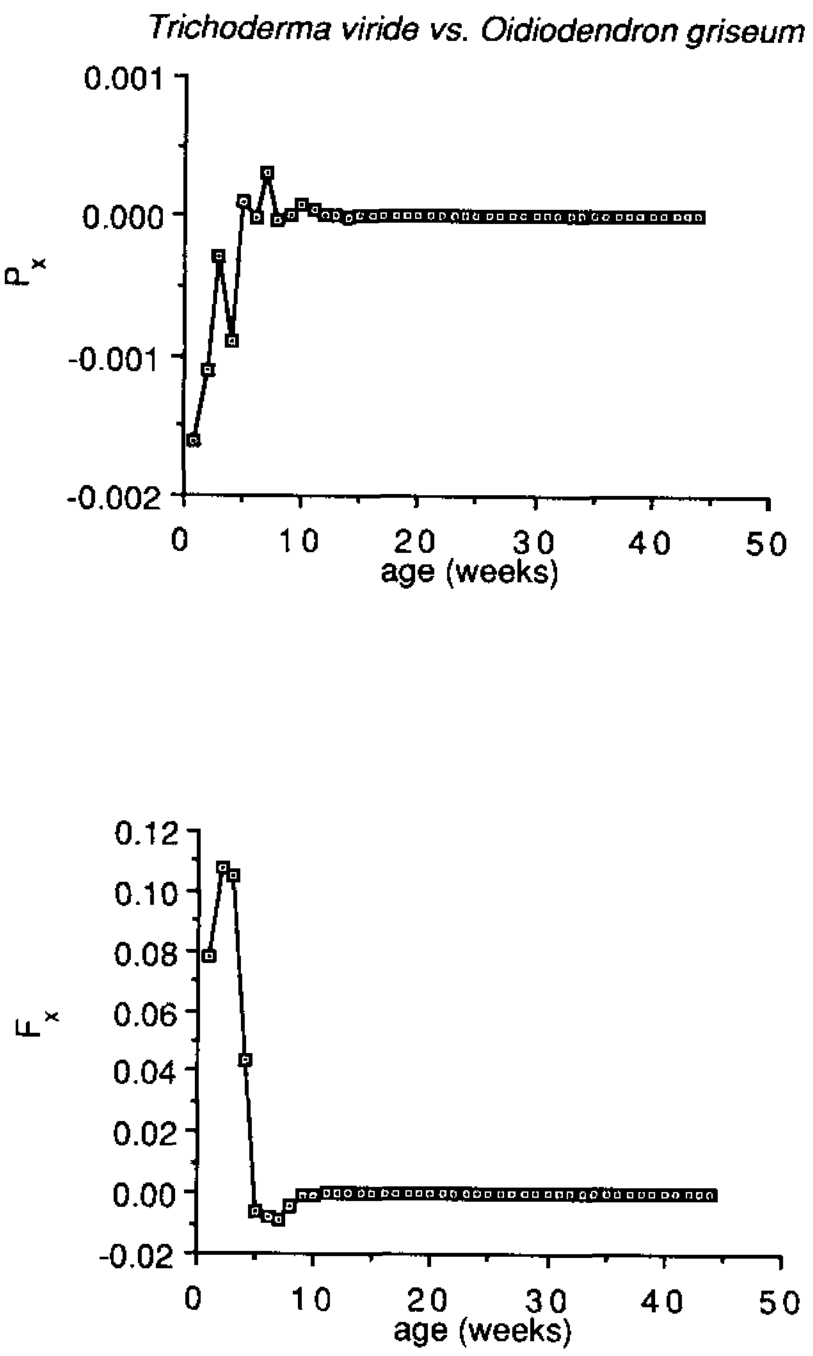

Fig. 4. Age-specific reproductive values of *Onychiurus furcifer* fed on *Trichoderma viride*, Sterile 4 and *Oidiodendron griseum*.

Fig. 5. Predicted stable age distribution of *Onychiurus furcifer* fed on *Trichoderma viride*, Sterile 4 and *Oidiodendron griseum*.

The sensitivity of the finite population growth rate ($\lambda$) to small changes in the projection matrix was calculated by the method of CASWELL (1978). This gives an indication of how age-specific fecundity ($F_x$) and survival probabilities ($P_x$) influence the population growth rate $\lambda$. It can also be used to quantify the contributions of fertility and survivorship to the differences in $\lambda$ between two populations. The advantages of animals fed on *T. viride* over those fed on *O. griseum* are illustrated in fig. 6. Up to week 5, *O. griseum* cultures have a survival advantage. However, from weeks 1–4, *T. viride* cultures have a fertility advantage which is greater than the survival advantage of *O. griseum* cultures. Therefore the growth rate on *T. viride* cultures is higher.

From weeks 1–2, Sterile 4 cultures have a survival advantage over *T. viride* cultures, this is transferred to *T. viride* cultures on week 3 (fig. 7). From weeks 1–4 and 6–8 *T. viride* cultures have a significant fertility advantage over Sterile 4 cultures resulting in a higher growth rate in *T. viride* cultures.

From weeks 1 and weeks 4–6, Sterile 4 cultures had a survival advantage over *O. griseum* cultures, from weeks 2–3 this was reversed giving almost the same advantage to *O. griseum* cultures (fig. 8). Sterile 4 cultures had just a slight fertility advantage initially although this too was



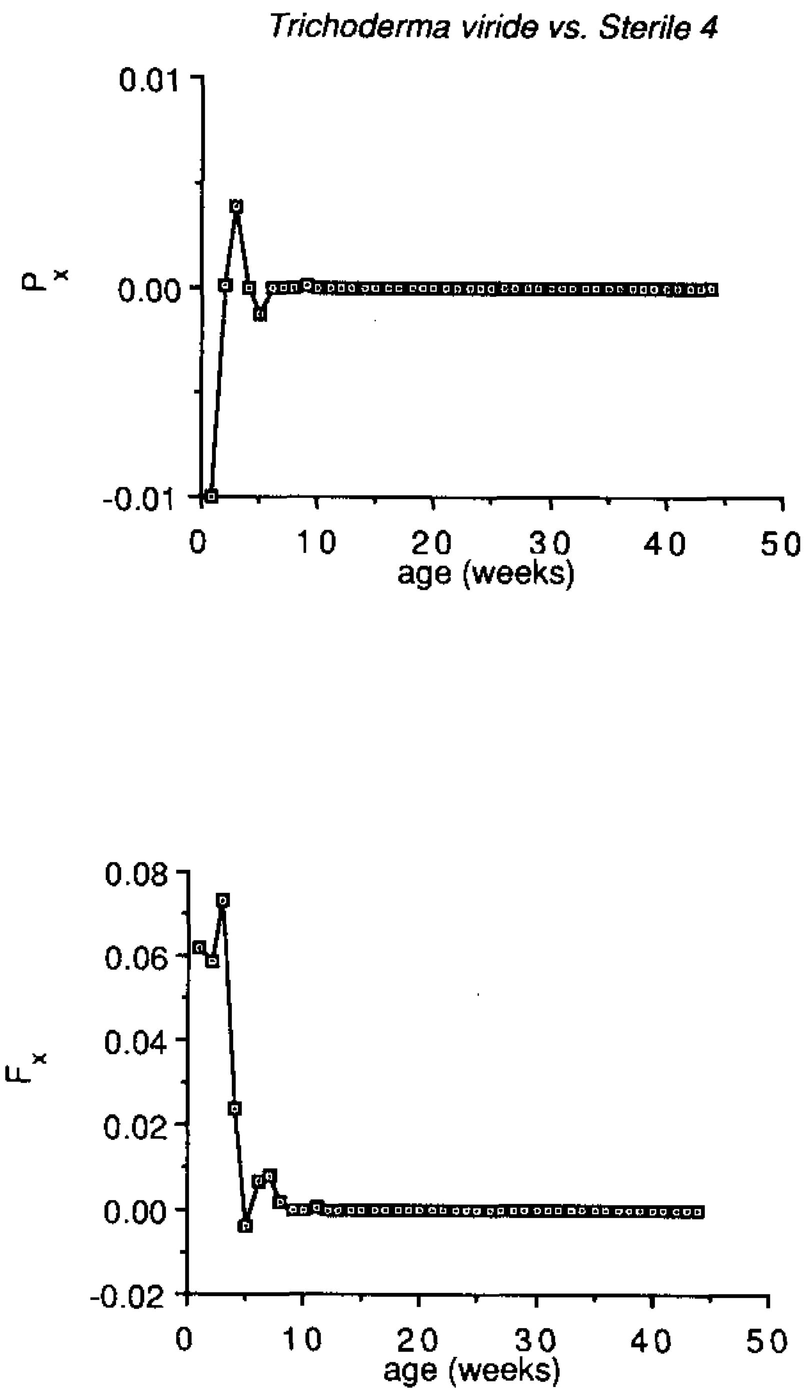




Fig. 6. The contributions of differences in age-specific survival probability ($P_x$) and age-specific fertility ($F_x$) to the population growth rate advantage of *Onychiurus furcifer* fed on *Trichoderma viride* as compared to those fed on *Oidiodendron griseum*.

Fig. 7. The contributions of differences in age-specific survival probability ($P_x$) and age-specific fertility ($F_x$) to the population growth rate advantage of *Onychiurus furcifer* fed on *Trichoderma viride* as compared to those fed on Sterile 4.

reversed in weeks 5–8 corresponding to the peak in reproductive activity ($v_x$) in *O. griseum* cultures seen in fig. 4.

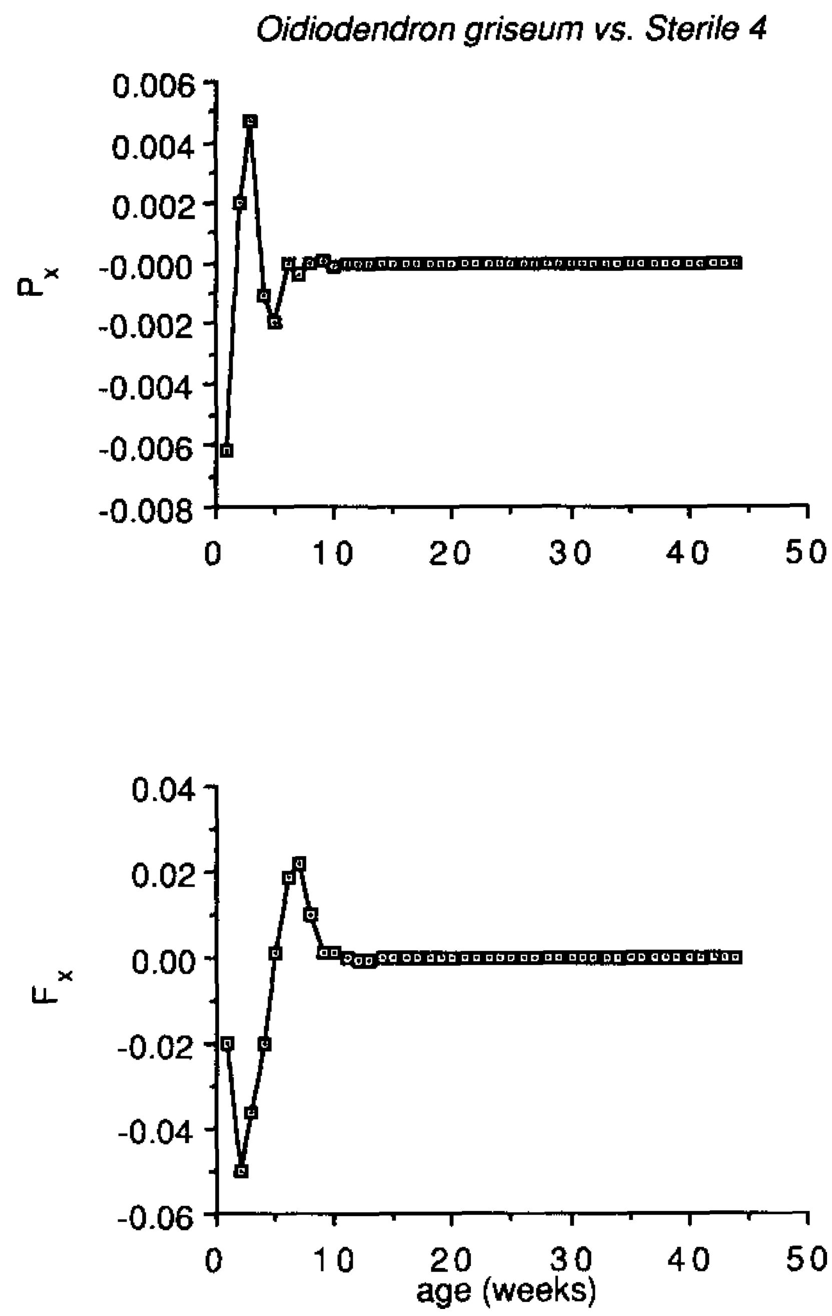
On all 3 combinations of fungal species only differences in fecundity and survival occurring in the first 10 weeks contribute to differences in growth rate. Therefore, the reproductive peak on week 36 in Sterile 4 cultures will not contribute significantly to differences in the population growth of this over other species.

### 3.3. Allometric growth

Differences in growth were assessed by fitting von Bertalanffy growth equations to the lengths measured in the experiments. The parameters of these equations are listed in table 4 and the raw data and fitted equations are shown in fig. 9. The asymptotic length ($L_\infty$) was similar for animals fed on *T. viride* (1.3 mm) and *O. griseum* (1.31 mm) while in Sterile 4 cultures it was significantly lower at 1.14 mm. However, animals feeding on Sterile 4 approach maximum length at a faster rate (k = .198) than those on the other fungi.

### 3.4. Sex ratios

The sex ratios of Collembola on each fungal species are given in table 5. There were no differences between the populations ($\chi^2 = 0.226$), each having approximately 40% males and 60% females.



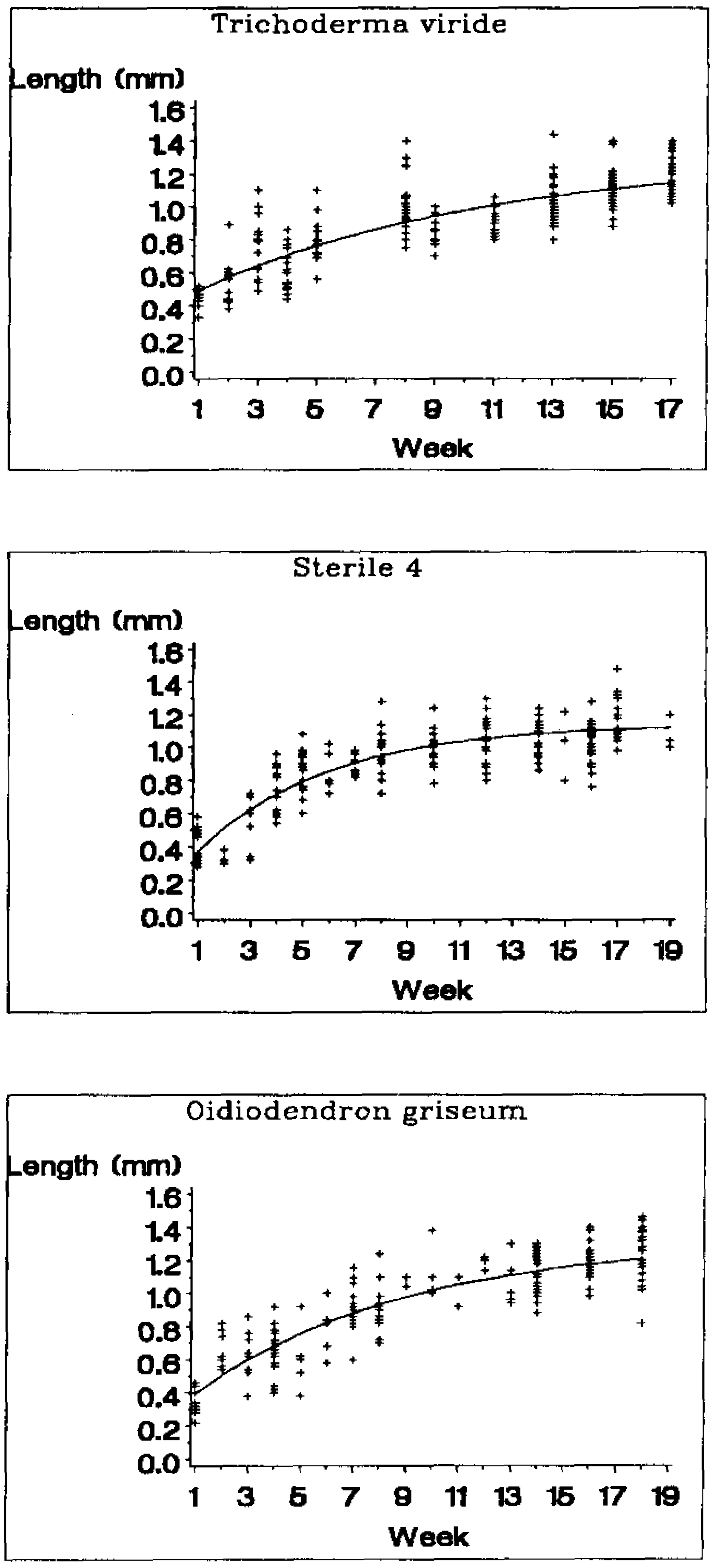




Fig. 8. The contributions of differences in age-specific survival probability ($P_x$) and age-specific fertility ($F_x$) to the population growth rate advantage of *Onychiurus furcifer* fed on *Oidiodendron griseum* as compared to those fed on Sterile 4.

Fig. 9. Growth in *Onychiurus furcifer* fed on *Trichoderma viride*, Sterile 4 and *Oidiodendron griseum*. Data is fitted to the VON BERTALANFFY equation: $L_t = L_{\infty} (1\text{-}e^{-k(t-ko)})$ (see table 4).

## 4. Discussion

The primary aim of this study was to determine whether different species of Collembola fed selectively on different species of fungi and whether the population dynamics of the animals reflected these preferences. A full complement of 45 preference tests was carried out on 3 species of Collembola, *O. furcifer, H. denticulata* and *I. thermophila,* and each of these showed significant preferences which were, for the most part, different from one another. *O. furcifer* and *H. denticulata* both preferred Sterile isolate 4 but later choices all differed considerably with species such as *O. griseum* being favoured by *O. furcifer* but not by *H. denticulata. I. thermophila* differed in favouring *Geotrichium* sp. and showing no preferences for the sterile isolates but was similar to both other species in disliking *T. polysporum* and *Penicillium* sp.

The relationship between these preferences and population dynamics is not simple. Food type had a definite effect on the population growth of *O. furcifer* but not on that of *H.*

Table 4. Growth data for *Onychiurus furcifer* from VON BERTALANFFY curve.

| Fungal species | $L_\infty$ | k | RMS | L | U |
|---|---|---|---|---|---|
| *T. viride* | 1.3 | .01 | .02 | 1.1 | 1.5 |
| Sterile 4 | 1.14 | .198 | .018 | 1.09 | 1.19 |
| *O. griseum* | 1.31 | .124 | .018 | 1.2 | 1.42 |

$L_t = L_\infty (1 - e^{-k(t-t_0)})$;
RMS = residual mean squares;
$L_\infty$ = theoretical mean maximum length (mm);
k = rate at which $L\infty$ is reached;
L and U = Lower and Upper 95% confidence limits;
t = time;
$t_0$ = hypothetical time estimated from hatching date for an individual of length 0.

Table 5. Sex ratios of *Onychiurus furcifer* fed on three species of fungus.

| Food species | Males | | Females |
|---|---|---|---|
| *T. viride* | 1 | : | 1.50 |
| Sterile 4 | 1 | : | 1.66 |
| *O. griseum* | 1 | : | 1.37 |

*denticulata*. *O. furcifer* achieved its greatest population size and fastest growth rates when feeding on *T. viride*, one of its least preferred species. This was due to a fertility advantage over individuals fed on the other species. However, there is a slight conflict between the results obtained from the fecundity/survivorship experiments and those which assessed population growth. In the former fertility is largest for animals fed on *T. viride* and there is no significant difference between the survivorship of those feeding on *T. viride* and Sterile 4. Yet, in the population growth experiments the populations fed on Sterile 4 grow more slowly than those fed on *T. viride* but eventually they become larger. This suggests that the contribution of reproduction by the older categories fed on Sterile 4 is more advantageous than appears in the analysis (cf. fig. 4 and fig. 7).

It is not clearly understood why species show consistent preferences. SHAW (1988) found *Onychiurus armatus* to have a clearly ranked order of preference for a series of fungi and suggested that it was related to the presence of toxins in the least preferred species. Others have drawn the same conclusion (e.g. VISSER & WHITTAKER, 1977; ADDISON & PARKINSON, 1978). Physical features of the food source were shown to be important by MILLS & SINHA (1971) who found that fungi which grew as low mats were preferred by *Hypogastrura tullbergi* and BENGTSSON *et al.* (1988) have found that odours play an important role in determining the attractiveness of species.

A number of studies have shown that the fertility and survivorship of Collembola are affected by the food type and its nutrient and heavy metal content (HEALY, 1965; VAIL, 1965; SNIDER, 1971; MILLS & SINHA, 1971; HARASYMEK & SINHA, 1974; BOOTH & ANDERSON, 1979; BENGTSSON *et al.*, 1983; BENGTSSON *et al.*, 1985). However, only SHAW (1988) has tried to relate variations in population dynamics to food preference. His results, for *O. armatus*, were very similar to those reported here for *O. furcifer*. The animals grew and reproduced most successfully on foods other than the preferred species. One possible explanation of this might be that nutrient content of the diet overrides the effect of preference. BOOTH & ANDERSON (1979) have shown that the nitrogen content of the food can have marked effects on survivorship and reproduction. This might explain some of the results in the present study, as the nitrogen content of *T. viride* was almost twice as large as that of the other 2 species. However, it does not explain why animals, fed Sterile isolate 4, the most preferred species, survive longer and have a higher net reproductive rate than those fed on *O. griseum* which had a higher nitrogen concentration.

Other studies have provided estimates of population parameters for *Onychiurus* species. HALE (1965) estimated that female *O. furcifer*, maintained at 8 °C, laid approximately 28 eggs during

their life. However, he noted that these animals grew much faster when maintained at higher temperatures. BENGTSSON *et al.* (1985) calculated $R_0$ and generation times for *O. armatus* fed on *Verticillium bulbillosum* which had been cultured on media containing varying concentrations of copper and lead. They estimated net reproductive rates of between $0.3 \times 10^{-3}$ and 27.7. The values for individuals grown on fungus not containing metals were 8.8 for the first generation and 12.0 for the second. Generation times varied from 10.4 to 16 weeks. Overall, it appears that *O. armatus* produces fewer offspring and has a longer generation time than *O. furcifer.* This may simply reflect differences in the culture conditions used but is, perhaps, more likely to reflect differences in the life history strategies of the euedaphic *O. armatus* and the hemiedaphic *O. furcifer.* HALE (1965) believed this reflected differences in their susceptibility to predation. BENGTSSON *et al.* (1983) and BENGTSSON *et al.* (1985) also found that differences in diet affected allometric growth, survivorship and fecundity among populations. However, the differential effects of metal contamination on survivorship and fertility were not quantified.

The difference between *H. denticulata* and *O. furcifer,* in the level of response of population growth to changes in the food may reflect differences in their life history strategies. *H. denticulata* is generally thought of as an opportunist species and an early colonizer of many habitats (BAWEJA, 1939; CURRY, 1979; THOMÈ & DESIÈRE, 1975; BOLGER & CURRY, 1980). As such it may not be as selective in its needs for growth and reproduction as species, such as *Onychiurus* spp., which are not generally considered as pioneer species.

In conclusion, it appears that many Collembola do show food preferences which differ from species to species and that the relationship between these preferences and the population dynamics of the species can be influenced by the nutrient content of the food and the life history strategy of the animals.

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**Synopsis:** *Original scientific paper*

WALSH, M. I., & T. BOLGER, 1990. Effects of diet on the growth and reproduction of some Collembola in laboratory cultures. Pedobiologia **34**, 161–171.

The preferences of 3 species of Collembola, *Onychiurus furcifer, Hypogastrura denticulata* and *Isotomina thermophila* were tested for 9 species of soil fungi; *Trichoderma viride, Trichoderma polysporum, Oidiodendron griseum, Oidiodendron maius,* a dark Sterile isolate Type 5, a light Sterile isolate Type 4, *Penicillium* sp., *Cladosporium* sp., *Geotrichum* sp. and malt agar. *O. furcifer* showed preferences in 40 of 45 tests, its most preferred being Sterile 4 and least preferred the two *Trichoderma* species. *H. denticulata* showed preferences in 26 tests. While Sterile 4 was also its most preferred fungus, it appeared to be less discriminating than *O. furcifer.* Although *I. thermophila* showed preferences in 26 tests, low numbers were recorded feeding. The population growth of *O. furcifer* and *H. denticulata* was monitored on 3 of the fungi; Sterile 4, the most preferred fungus of both species, *O. griseum,* which was highly preferred by *O. furcifer* but less so by *H. denticulata* and *T. viride* which was preferred by *H. denticulata* but numbers when fed on *T. viride,* whereas *O. griseum* appeared to be least conductive to growth. However, food type had no effect on population growth of *H. denticulata* and further work was confined to *O. furcifer.* Survivorship of *O. furcifer* was greater in animals fed on *T. viride,* and Sterile 4 than in those fed on *O. griseum.* The net reproductive rates ($R_0$) were 52.2 for *T. viride,* 47 for Sterile 4 cultures and 37.4 for *O. griseum* cultures. Generation time was shortest in *T. viride* cultures at 6.02 weeks and longest in *O. griseum* cultures at 7.4 weeks. In the Sterile 4 cultures, the generation time was 7.2 weeks. The finite population growth rates ($\lambda$) were 1.93 for *T. viride,* 1.7 for Sterile 4 and 1.63 for *O. griseum* cultures. The age-specific reproductive values ($v_x$) reached a peak on week 7 in both *T. viride* and *O. griseum* cultures, but reached a maximum much later in Sterile 4 cultures, on week 36. An estimate was made of how age-specific fertility and survival probabilities influence the population growth rate ($\lambda$), this showed that animals feeding on *T. viride* had a strong fertility advantage over animals feeding on either of the other two species. Fitting the VON BERTALANFFY growth equation to length data showed that the maximum theoretical length reached by *O. furcifer* was similar in *T. viride* and *O. griseum* cultures at 1.3 mm, while in Sterile 4 cultures it was 1.14 mm. However, growth rate was fastest in Sterile 4 cultures. Sex ratios were similar in all 3 cultures with approximately 60% female to 40% male.

**Key words:** Collembola, food preference, population dynamics, survivorship; fecundity; growth; sex ratio.

**Address:** M. I. WALSH and T. BOLGER (corresponding author), Department of Zoology, University College of Dublin, Belfield, Dublin 4, Ireland.